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III. *A Letter to William Heberden, M. D. Fellow of the Royal College of Physicians in London, and of the Royal Society, from Daniel Peter Layard, M. D. Physician to her Royal Highness the Princess Dowager of Wales, Member of the Royal College of Physicians in London, and of the Royal Societies of London and Gottingen; giving an Account of the Somersham Water, in the County of Huntingdon; and transmitting a Letter from Michael Morris, M. D. F. R. S. Member of the Royal College of Physicians in London, and Physician to the Westminster Hospital, to Dr. Layard, on the same Subject.*

Dear Sir,

Read Feb. 6, 1766. **A**T last I venture to lay before you the result of those experiments and observations, which I have made on the Somersham water. They were undertaken with your approbation, and pursued through your encouragement.

To ascertain the contents of a mineral water, requires a repetition of the analysis; and notwithstanding the experiments have been repeated these fourteen years last past, either at the spring, at Huntingdon,

don, or in London, and the effects of this water carefully observed in the many cases it has been drank, yet I could not before presume to offer you a positive determination, till I was convinced, by the trials of an abler and more competent judge, that I was not mistaken. But now through the obliging and friendly assistance of Dr. Morris, I am enabled to communicate to you, and the public, the great utility and excellence of a medicinal water, well known and esteemed many years ago. By a repetition also of every experiment made in the country, Dr. Morris, has in his laboratory, and in my presence, ascertained the contents and properties of the Somersham water; nay more, as you will observe, Sir, by Dr. Morris's letter annexed, one considerable ingredient, namely allum, has been not only proved to exist in this water, but likewise the Dr. has produced crystals of allum, which Doctors * Lucas and Ratty † declare, have not yet been procured from any water, although allowed to contain an aluminous salt.

I shall not trouble you, Sir, with a detail of all the common experiments so well known to you, and which I had the satisfaction of shewing you, and many gentlemen of the different branches in the profession of physic, at my house the two last summers; but proceed to an account of the water, and its contents.

The Somersham water, commonly called the Somersham Spa, issues out from the declivity of a small hill, which is situated on a heath, bearing the same

* Vol. II. p. 24. Essay on Waters.

† P. 299. Synopsis of Mineral Waters.

name, and laying near the high road, between the towns of St. Ives and Somersham, in the county of Huntingdon, about three miles distance from St. Ives. This heath was formerly covered by part of the royal forests cut down in the reigns of Henry II. III. or of Edward I. and now serves only for the grazing of sheep.

The different strata of the earth on this heath are, immediately under the sward, first, about six inches depth of mould, or arable, then different strata of clay, each stratum about ten or twelve inches deep, growing darker from a yellowish or grey color, to a dark blue golt the deeper it lies. At about seven feet deep is found a bed of gravel, out of which the water springs forth very clear. This stratum of gravel is about twelve or fourteen inches thick, surrounded with a bed of a very dark blue golt, beset with large quantities of selenites, which have shot in it, and are surrounded with some fine yellow clay sticking to them.

The water, flowing from this spring,, which is perennial, but runs more or less according to the different seasons, is received from the bed of gravel by three small brick channels, about two feet long, which meet in one of about six inches square. This channel which is near twenty feet in length, conveys the water to a basin also of brick, and about two feet square. The channel and basin were made about 40 years ago under the direction of the late Rev. Dr. Knight; were opened and cleaned in the years 1755 and 1759, when I directed the workmen to new lay the bricks of the channel in some of the stiff blue clay, instead of lime-mortar, that the water might
be

be less liable to a decomposition in its passage. From the basin the water frequently overflows, and runs trickling along a trench into a small brook ; wherever it stops, it leaves the clay ground tinged of a rusty ochry color, and the water stagnating is covered with a thick pellicle variegated of many colors. In frosty weather, I have often found stalactites hanging round the edges of the basin, which, upon examination, were formed by the selenites impregnated with the vitriol of iron, changing their white appearance to a rusty yellow-colored crust covering the stalactites.

The water taken up out of the basin, is generally clear and transparent, unless after heavy rains, when it appears thick and of a muddy yellow ; or when the basin has not been cleaned some time, lumps of a black gelatinous substance, like the sediments in ink bottles, are taken out from the bottom of the basin.

By dipping carefully a glass into the basin in a dry season and fair weather, the water is quite clear, full of bubbles sparkling up, some of which stick to the sides of the glass. By the hydrostatical balance, its weight differs from distilled rain water, weighed at the well, as $1006 \frac{1}{2}$ is to 1000 ; when carried to Huntingdon, as 1010, to 1000 ; and brought to London, it has about the same weight.

The Somersham water, drank at the spring, is cool, pungent, and of an austere, sharp, astringent, ferruginous taste, somewhat inky, but not in the least disagreeable ; when carried to any distance, it loses a little of its pungency, by its suffering a decomposition ; but carefully bottled under water, and then

then well corked, covering afterwatds the corks closely with rosin and wax, the water preserves its briskness and volatility a long while, and provided the bottle be kept corked, though half the water may have been drawn out, yet after keeping it months, nay many years, it will still preserve its irony principle, so as to turn with galls, purple, or dark blue.

Experiments at the Spring Head.

Experiment I.

Half a grain of powdered galls turns a pint of Somersham water of a dark purple.

Experiment II.

Brandy, or rum, drawn from oak casks, or an infusion of green tea leaves, turns it of a blackish cast.

Experiment III.

Vegetable, nor mineral acids, cause the least alteration in the water, which remains clear, and without the least effervescence.

Experiment IV.

Alcalies, whether volatile or fixed, cause an effervescence and turn the water green and curdled.

Experiment V.

It mixes with milk without alteration.

Experiment

Experiment VI.

Syrup of violets turns the water green.

Experiments at home, in Huntingdon.

Experiment VII.

Half a grain of galls powdered turned a pint of Somersham water of a dark mazarine blue, inclining to purple.

Experiment VIII.

In two vials were poured some Somersham water, each vial containing eight ounces. In one had been put two drams of filings of iron. After standing twenty-four hours in a moderate warm place, three grains of powdered galls were added to each vial. The pure Somersham water immediately turned purple, with the galls, which next day fell like a purple sediment to the bottom, and left the supernatant liquor clear. The water poured on the filings of iron threw up several air bubbles, turned black as ink, some few hours after the addition of the three grains of galls; and kept that color, and an inky taste, several days; after which the black sediment fell likewise to the bottom, and left a clear supernatant water, which still preserved its inky taste.

Experiment

Experiment IX.

Brandy, or rum, drawn from oak casks, or an infusion of green tea leaves, produced a purple color, inclining to black.

Experiment X.

Somersham water doth not lather with soap, but curdles immediately.

Experiment XI.

Acids cause no alteration, but mix as at the spring head.

Experiment XII.

Volatile or fixed alcalies did not effervesce with the Somersham water, at home, as at the spring head, but produced a cloud, then curdled, and threw down a sediment.

Experiment XIII.

The Somersham water, in a few hours, lets fall an ochry sediment to the bottom of the bottle, which is of a different color, according to the season in which the water is taken up; in dry times, the sediment is of a rusty, cinnamon, or orange color; in wet weather, it is of an olive, or brown color, smelling like the fumes of sulphur.

Experiment

Experiment XIV.

After the first separation of the ochry sediment, the water continues clear, and transparent; and notwithstanding I have kept some bottles half full, months, and years, yet the water preserved its purity, and would in a lesser degree turn purple with galls.

Experiment XV.

The water being filtered from the ochre, which was precipitated at the bottom of the bottle, and then put on the fire, emits many air bubbles, then grows turbid and yellow, and after a little evaporation throws up a thick scum, which separated by filtration proves to be a fine ochre beset with selenites. The water will then, after boiling, turn purple with galls. By accident I let fall some hot Somersham water on an iron fender, which it instantly turned to so many blue spots, as there were drops on the fender.

Experiment XVI.

After this second filtration, the water appears greenish at the top, and lets fall a white sediment; when the liquor is evaporated to nearly the quantity of half an ounce, a thick pellicle is formed.

Experiment XVII.

If to this residuum a small quantity of distilled rain water be added warm, and then filtered, a very
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white sediment will be separated¹; and the rain water being evaporated to a pellicle, will leave a brown deposit, which will appear to be a bitter muriatic salt, containing sometimes a few crystals.

Experiment XVIII.

The Somersham water mixes well with warm and boiling milk, when carried at a distance as well as at the spring head; but when equal quantities of the water and milk are boiled together, then the milk is turned immediately, the curd of which becomes of a bright pink color with galls, the whey of a reddish brown, and both are of an agreeable rough and ferruginous taste.

Experiment XIX.

To discover if the water contained any allum, according to Dr. Shaw's direction, some leaves of the herb *Geranium Robertianum*, commonly called Ragged Robert, were infused in four ounces of Somersham water, a comparison made between this infusion, and one of the same herb, in the same quantity of distilled rain water, and another in as much distilled rain water, with two grains of allum powdered. The glasses were all placed in a moderate heat, and the several infusions appeared, as follows, after standing twenty four hours; the Somersham water of a purple color, with a reddish hue; the rain water, with allum, of a green, with a reddish cast; and the rain water of a fine green. The herb subsides with the Somersham water, floats

in the middle with the aluminous rain water, and swims on the top in the simple rain water. The herb is turned purple, by infusion, in the Somersham water; is of a yellow green in the rain water with allum; and remains of a bright green when infused in rain water alone.

Experiment XX.

The sediments, by evaporation, from Somersham water differ, as is said, of the spontaneous separation, in Experiment 13. according to the seasons, both as to color and quantity. Four pounds of the Somersham water have, by evaporation, yielded in a dry season, sixteen, or at most twenty grains of a rusty colored, or orange colored sediment; whereas, after rainy weather, two pounds of the same water have yielded one dram of a dark olive brown sediment.

Experiment XXI.

I put two drams of the yellow ochry sediment into a crucible, covered with a tile, and having calcined it in an open fire, it had lost a sixth part of its weight; the residuum appeared of a red rusty color, mixed with a white earth; and on the sides of the crucible a small quantity of greyish powder sticking to it. The red powder was partly attracted by the magnet.

Experiment XXII.

I put, at the same time, into another crucible, a lump of the blue clay, brought from the Somersham Spa,

weighing about two ounces ; this clay was intermixed with small shoots of selenites, surrounded with the fine yellow ochry clay mentioned above. After calcination, part of the clay had vitrified, part was become of a dark red, and the selenites were burnt to a white powder.

Experiment XXIII.

I threw some of the white sediment, procured by filtration and evaporation mentioned in Experiment 17. on a red hot iron ; it partly blistered up, and turned of a greyish color, and the remainder, which was the greater quantity, appeared of a very clear white.

Experiment XXIV.

Having, by evaporation and filtration, procured some selenites from the Somersham water, I threw it into a red hot crucible, wherein it partly swelled up like blisters, and when cold appeared of a greyish white, intermixed with particles of iron.

These Experiments plainly demonstrate, Sir, that the following contents are to be found in the Somersham water. First, by Exp. 1, 2, 6, 7, 8, 9, 13, 14, 15, 18, 20, 21, 24, iron. Secondly, by Exp. 13, 16, dissolved pyrites. Thirdly, by Exp. 1, 3, 4, 10, 11, 12, 14, 16, 18, a vitriolic acid. Fourthly, by Exp. 22, 23, 24, a calcarious earth. Fifthly, by Exp. 15, an ochre. Sixthly, by Exp. 15, 16, 21, 22, 23, 24, selenites. Seventhly, by Exp. 17, a muriatic salt, which doth not crystallize, And, Eighthly, by Exp. 18, 19, 21, 23, 24, allum.

The

The Somersham water, therefore, is a chalybeate water, strongly impregnated with the vitriol of iron and allum, and containing some calcarious earth, felenites and salt.

It would be absurd in me to trouble you, Sir, either with any more experiments, or the relation of the several cases, in which I have found the salutary effects of the Somersham water, since no one knows its properties better than you, Sir, nor directed it formerly with greater efficacy. I shall, therefore, now lay before you Dr. Morris's letter, in confirmation of what I have said, and only mention, that upon the several trials made with this water on human calculi, both at Huntingdon and in London by me, and lately by Dr. Morris, the Somersham water has acted powerfully on those substances; that it mixes well with the blood, and passes visibly with the urine. But these experiments, and the above-mentioned cases, trite as they must be to you, may probably, with other particulars relating to the county of Huntingdon, be laid before the public at some other time.

I am happy in this opportunity of acknowledging myself, with the greatest regard,

Dear Sir,

Your most obliged,

and most obedient humble servant,

Lower Brook-street,
Nov. 15, 1765.

D. P. Layard.

Letter

A Letter from Michael Morris, M. D. Member of the Royal College of Physicians in London, and of the Royal Society, to Daniel Peter Layard, M. D. Physician to Her Royal Highness the Princess Dowager of Wales, Member of the Royal College of Physicians in London, and of the Royal Societies of London and Gottingen, relating to Experiments made on the Somersham Water.

Dear Sir,

FROM your very accurate account of the singular mineral water, found at Somersham, in Huntingdonshire, and its salutary effects in many obstinate diseases, it appears to be highly deserving the attention of the public. I, therefore, agreed with pleasure to your proposal of repeating the experiments here, which you had formerly made at the spring head, and at Huntingdon; and adding such as you were obliged to omit in the country for want of a proper apparatus.

As you intend to oblige the public with an account of the former, to which our repeated trials here were perfectly conformable, I shall confine myself in the following narrative, principally to the latter, at which you assisted in my laboratory.

Experiments on the Somersham Water.

The water seemed clear in the bottles, though there was some sediment at the bottom. It was clear and bright when poured into a glass, but did not sparkle nor emit air bubbles for a considerable time

time. It was austere, subacid, and chalybeate to the taste.

Experiment I.

On adding five grains of powdered galls to a glass of the water, it soon became of a muddy blue, which in a little time changed to a light purple.

Several bottles of the water, which had been kept upwards of two months, exhibited the same appearances.

The water, in some bottles, which had been half emptied on purpose, and corked slightly, still preserved its property of striking a blue and purple with galls, though more faint.

From these experiments, the Somersham water appears manifestly to have preserved its ferruginous quality, notwithstanding the long carriage from the spring to London, and to have lost very little of it for a considerable time after, which renders it a valuable acquisition to the public, as there are very few mineral waters, generally known in England, that do not lose their chalybeate properties in a few days, and even at a small distance from their source; which renders the importation of the foreign chalybeate waters absolutely necessary, at a considerable price.

Experiment II.

Two pounds of the Somersham water were exposed to a gradual fire in a glass retort luted to a receiver.

The

The water, as it grew warm, became turbid, and discharged air bubbles, depositing at the same time an ochry sediment at the bottom. These appearances ceased before eight ounces were drawn off by distillation.

The distilled water, proving on examination, to be no wise different from common distilled water, the distillation was discontinued; the contents of the retort were poured into a white basin; on standing a night to settle, the liquor in the basin seemed clear, and a yellow sediment was seen at the bottom; the clear liquor was decanted into another basin.

The sediment carefully dried, weighed near four grains, and proved to be chiefly ferruginous.

The clear liquor was suffered to evaporate, by the heat of the atmosphere, in the month of August; pellicles were formed successively on the surface, which breaking in a little time fell to the bottom; this continued until there remained about two ounces of liquor, which was poured carefully from the pellicles into a cup, and was set to evaporate in a moderate heat. The dried pellicles weighed 30 grains. They were insipid, gritty, and not soluble in water.

Experiment III.

Six grains of the pellicles, exposed to a strong fire, in a covered crucible, for three hours, became reddish when cold, and lost a grain in weight; but seemed not altered in other respects.

Experiment

Experiment IV.

Six grains of the same pellicles exposed on a test to a reverberatory heat for the same space of time; the vitriolic acid being volatilized, by the reverberated flame, was expelled from its terrene basis, so that the residuum, when cold, weighed but three grains, was acrid to the taste, grew hot with water, and communicated the same qualities to it that lime does. Hence the saline pellicles deposited by evaporation, appear to be the selenites, or the vitriolic acid, united to a calcarious earth, with a little iron.

Experiment V.

The liquor in the cup being quite evaporated, there remained some regular crystals standing in a whitish powder; the crystals weighed five grains, and proved on examination to be regular crystals of allum.

Experiment VI.

The whitish powder soon attracted moisture from the air, and in the space of 24 hours ran, *per deliquium*, into a brownish subacid austere liquor, of a ferruginous and saline taste.

It appears from these experiments, that the contents of the Somersham water are: First, Iron. Secondly, Selenite. Thirdly, Allum. Fourthly, From its taste, and attracting the moisture of the air, some marine salt, with a little allum and vitriol

in the state of an *aqua magistra aluminis & vitrioli*, incapable of crystallization.

The Somersham water, therefore, seems to differ considerably from any of the mineral waters known in Great Britain or Ireland *. For among the writers, who even admit and mention aluminous waters, no one, except Dr. Short, pretends to have separated crystals of allum from them ; and even he declares, that in subsequent trials on the Nevil Holt water (from which he had once obtained some) he could not succeed.

Though if we consider that allum is composed of the vitriolic acid, united to an argillaceous earth, it will not be difficult to conceive that an acid water, passing through a stratum of such earth, should act upon, and unite with a small portion of it ; or the water may dissolve some allum in the stratum of decomposed pyrites, where it is impregnated with iron and selenite. So that probably allum has been often overlooked in water wherein it existed ; nor did we obtain any in our experiments, until nearly all the selenite had been separated.

However, as allum is a very powerful medicine ; the quantity discovered in the Somersham water, must have contributed not a little to its efficacy, in some of the remarkable cases wherein you have observed its success.

I am,

S I R,

Your obliged humble Servant,

Michael Morris.

* Rutty Synopsis of Mineral Waters, p. 299. Lucas Essay on Waters, Vol. II. p. 24.